

CLAIMS:

WHAT IS CLAIMED IS:

1. A process to produce a molded carbon alloy material at process temperatures below the melting point of carbon comprising:
 - selecting a carbon containing feed source as a carbon base for the carbon alloy material to be produced;
 - controlling ash content of the feed source by measurement and adjustment to a desired ash content;
 - adjusting reactivity of the feed source by heating the feed source to a temperature below the melting point of carbon to increase the surface area and the internal void volume of the feed source or by adding and blending a feed modifier into a homogeneous mixture with the feed source or by a combination of heating, and adding and blending a feed modifier into a homogeneous mixture with the feed source;
 - molding the feed source and any added and blended feed modifier under pressure and at a temperature below the melting point of carbon to produce a shaped material;
 - curing the molded shaped material;
 - adhering and nucleating the carbon in the shaped material;
 - collapsing voids in the shaped material by heating to a temperature below the melting point of carbon; and
 - cooling of the shaped material to produce the molded carbon alloy.
- 2 The process of claim 1, wherein selecting the feed source comprises selecting the feed source from a group consisting of refuse coals, coal tailings, agricultural wastes, polymeric wastes, lignite, non-coking coals, non-caking coal fines, caking

coals, degraded polymers, refuse carbonaceous materials from tires, and municipal solid waste with or without inorganic components.

3. The process of claim 1, wherein the feed source comprises a plurality of feed sources selected from the group consisting of refuse coals, coal tailings, agricultural wastes, polymeric wastes, lignite, non-coking coals, non-caking coal fines, caking coals, degraded polymers, refuse carbonaceous materials from tires, municipal solid with or without inorganic components.
4. The process of claim 1, wherein selecting the feed source comprises determining thermal behavior and pyrolysis kinetics of the feed source.
5. The process of claim 1, wherein the feed source has an ash content less than about 40%.
6. The process of claim 1, wherein controlling ash content comprises reducing and modifying ash content of the feed source.
7. The process of claim 6, wherein reducing and modifying ash content comprises an act selected from acts of physical doping, separation, chemical wash, physical wash or combinations thereof.
8. The process of claim 6, wherein reducing and modifying ash content of the feed source results in an ash content no greater than about 8%.
9. The process of claim 8, wherein the reducing and modifying ash content of the feed source results in an ash content within a range of about 1 - 4%.

10. The process of claim 1, wherein adjusting reactivity of the feed source comprises altering reactivity by heating.
11. The process of claim 10, wherein the heating comprises thermolysis.
12. The process of claim 10, wherein the heating comprises pyrolysis.
13. The process of claim 10, wherein the thermal conversion occurs between about 150 - 800°C, at a heating rate of about 1 - 1000°C/min.
14. The process of claim 1, further comprising enhancing strength and fluidity of the feed source by adding materials to the feed sources.
15. The process of claim 14, wherein the materials added to enhance strength and fluidity are selected from a group of materials consisting of silica, coke breeze, molasses, tar, pitch, synthetic polymers, alcohols, and combinations thereof.
16. The process of claim 1, further comprising adding an inorganic and homogenizing the feed source.
17. The process of claim 16, wherein the inorganic comprises silica.
18. The process of claim 1, wherein adding a feed modifier to the feed source comprises adding a material selected from a group consisting of synthetic and natural hydrocarbon materials.

19. The process of claim 1, wherein adding a feed modifier comprises adding a material selected from a group consisting of virgin polymers, vinyl acetates, methacrylates, ethylenes, polymeric resins, recycled automobile wastes, recycled polymeric wastes, agricultural wastes, agricultural oils, agricultural fats, molasses, biomass tar fluids, biomass pitches, coal tar, coal pitch, activated carbon bases, carbon residues from industrial wastes, inorganic fractions from agricultural residues, and combinations thereof.
20. The process of claim 1, wherein adding a feed modifier comprises adding a plurality of materials selected from a group consisting of virgin polymers, vinyl acetates, methacrylates, ethylenes, polymeric resins, recycled automobile wastes, recycled polymeric wastes, agricultural wastes, agricultural oils, agricultural fats, molasses, biomass tar fluids, biomass pitches, coal tar, coal pitch, activated carbon bases, carbon residues from industrial wastes, inorganic fractions from agricultural residues, and combinations thereof.
21. The process of claim 1, wherein molding the feed source and added feed modifier to produce a shaped material comprises molding a shape having a length dimension of about 0.5-9 inches, a width dimension of about 0.5-9 inches and a height dimension of about 0.25-6 inches.
22. The process of claim 1, wherein curing the molded shaped material comprises heating to a range of about 150°C - 500°C at a heating rate ranging from about 1°C/ minute - 100°C/ minute.
23. The process of claim 1, wherein curing the molded shaped material comprises heating the material in an inert environment.

24. The process of claim 1, wherein adhering and nucleating the carbon in said shaped material comprises heating the material to a range of about 300°C - 700°C at a heating rate ranging from about 1°C/ minute - 100°C/ minute.
25. The process of claim 1, wherein collapsing voids in the shaped carbon material comprises heating the shaped carbon material using forced convection.
26. The process of claim 25, wherein the heating is to a temperature range of about 700 - 1300°C at a heating rate ranging from about 1 - 30°C/minute.
27. The process of claim 25, wherein collapsing voids is done in a controlled atmosphere of less than about 5% oxygen, less than about 10% CO₂, and less than about 10% at the gas-solid interface.
28. The process of claim 25, wherein collapsing voids is done in a controlled atmosphere of less than about 5 % oxygen, more than about 10% CO₂, and more than about 10% water in the bulk gas phase.
29. The process of claim 1, wherein cooling the shaped material to produce the carbon alloy comprises forced convection cooling in an inert atmosphere.
30. The process of claim 29, wherein a maximum temperature gradient throughout the shaped material is maintained in a range of about 100°C - 500°C per maximum dimension of the shaped material.
31. A carbon alloy material made by a process at temperatures below the melting point of carbon comprising:

selecting a carbon containing feed source based on the property requirements of the carbon alloy material to be produced;
controlling ash content of the feed source;
selectively controlling reactivity of the feed source;
adding a feed modifier to the feed source;
molding the feed source and added feed modifier to produce a shaped material;
curing the molded shaped material;
adhering and nucleating the carbon in the shaped material;
collapsing voids in the shaped carbon material; and
cooling of the shaped material to produce the molded carbon alloy.

32. The carbon alloy material made by the process of claim 31, wherein the feed source is selected from the group consisting of refuse coals, coal tailings, agricultural wastes, polymeric wastes, lignite, non-coking coals, non-caking coal fines, caking coals, degraded polymers, refuse carbonaceous materials like tires, municipal solid waste, and inorganics.
33. The carbon alloy material made by the process of claim 31, wherein the feed source comprises a plurality of feed sources selected from the group consisting of refuse coals, coal tailings, agricultural wastes, polymeric wastes, lignite, non-coking coals, non-caking coal fines, caking coals, degraded polymers, refuse carbonaceous materials like tires, municipal solid waste, and inorganics.
34. The carbon alloy material made by the process of claim 31, wherein selecting the feed source comprises determining thermal behavior and pyrolysis kinetics of the feed source.

35. The carbon alloy material made by the process of claim 31, wherein the feed source has an ash content less than about 40%.
36. The carbon alloy material made by the process of claim 31, wherein controlling ash content comprises reducing and modifying ash content of the feed source.
37. The carbon alloy material made by the process of claim 36, wherein reducing and modifying ash content comprises an act selected from acts of physical doping, separation, chemical wash, physical wash or combinations thereof.
38. The carbon alloy material made by the process of claim 36, wherein reducing and modifying ash content of the feed source results in an ash content no greater than about 8%.
39. The carbon alloy material made by the process of claim 38, wherein the reducing and modifying ash content of the feed source within the range of about 1 - 4%.
40. The carbon alloy material made by the process of claim 31, wherein selectively controlling reactivity of the feed source comprises altering reactivity using thermal conversion.
41. The carbon alloy material made by the process of claim 40, wherein the thermal conversion comprises a thermolytic environment.
42. The carbon alloy material made by the process of claim 40, wherein the thermal conversion comprises a pyrolytic environment.

43. The carbon alloy material made by the process of claim 40, wherein the thermal conversion occurs between about 150°C - 800°C, at a heating rate of about 1°C/min - 1000°C/min.
44. The carbon alloy material made by the process of claim 31, further comprising enhancing strength and fluidity of the feed source by adding materials to the feed sources.
45. The carbon alloy material made by the process of claim 44, wherein the materials added to enhance strength and fluidity are selected from a group of materials consisting of silica, coke breeze, molasses, tar, pitch, synthetic polymers, alcohols, and combinations thereof.
46. The carbon alloy material made by the process of claim 31, further comprising adding an inorganic and homogenizing the feed source.
47. The carbon alloy material made by the process of claim 46, wherein the inorganic comprises silica.
48. The carbon alloy material made by the process of claim 31, wherein adding a feed modifier to the feed source comprises adding a material selected from a group consisting of synthetic and natural hydrocarbon-based materials.
49. The carbon alloy material made by the process of claim 31, wherein adding a feed modifier comprises adding a material selected from a group consisting of virgin polymers, vinyl acetates, methacrylates, ethylenes, polymeric resins, recycled automobile wastes, recycled polymeric wastes, agricultural wastes, agricultural oils, agricultural fats, molasses, biomass tar fluids, biomass pitches,

coal tar, coal pitch, activated carbon bases, carbon residues from industrial wastes, inorganic fractions from agricultural residues, and combinations thereof.

50. The carbon alloy material made by the process of claim 31, wherein adding a feed modifier comprises adding a plurality of materials selected from a group consisting of virgin polymers, vinyl acetates, methacrylates, ethylenes, polymeric resins, recycled automobile wastes, recycled polymeric wastes, agricultural wastes, agricultural oils, agricultural fats, molasses, biomass tar fluids, biomass pitches, coal tar, coal pitch, activated carbon bases, carbon residues from industrial wastes, inorganic fractions from agricultural residues, and combinations thereof.
51. The carbon alloy material made by the process of claim 31, wherein molding the feed source and added feed modifier to produce a shaped material comprises molding a shape having a length dimension of about 0.5-9 inches, a width dimension of about 0.5-9 inches and a height dimension of about 0.25-6 inches.
52. The carbon alloy material made by the process of claim 31, wherein curing the molded shaped material comprises heating to a range of about 150 - 500°C at a heating rate ranging from about 1°C - 100°C/ minute.
53. The carbon alloy material made by the process of claim 31, wherein curing the molded shaped material comprises heating the material in an inert environment.
54. The carbon alloy material made by the process of claim 31, wherein adhering and nucleating the carbon in said shaped material comprises heating the material to a range of about 300 - 700°C at a heating rate ranging from about 1°C - 100°C/minute.

55. The carbon alloy material made by the process of claim 31, wherein collapsing voids in the shaped carbon material comprises heating the shaped carbon material using forced convection.
56. The carbon alloy material made by the process of claim 55, wherein the heating is to a temperature range of about 700°C - 1300°C at a heating rate ranging from about 1°C/minute - 30°C/minute.
57. The carbon alloy material made by the process of claim 55, wherein collapsing voids is done in a controlled atmosphere of less than about 5% oxygen, less than about 10% CO₂, and less than about 10% water near the gas-solid interface.
58. The carbon alloy material made by the process of claim 55, wherein collapsing voids is done in a controlled atmosphere of less than about 5 % oxygen, more than about 10% CO₂ , and more than about 10% water in the bulk gas phase.
59. The carbon alloy material made by the process of claim 31, wherein cooling the shaped material to produce the carbon alloy comprises forced convection cooling in an inert atmosphere.
60. The carbon alloy material made by the process of claim 59, wherein a maximum temperature gradient throughout the shaped material is maintained in a range of about 100 - 500°C.
61. A carbonaceous material comprising:
A particulate of partially pyrolyzed carbon (PPC) base formed on heating a carbon-containing feed material to a temperature below the melting point of

carbon; and a nucleating agent in the form of a interactive filler in said PPC base, said nucleating agent adhered together to said PPC particles by application of heat to a temperature below the melting point of carbon.

62. The carbonaceous material of Claim 61 wherein said carbon-containing feed material is selected from the group consisting of refuse coals, coal tailings, agricultural wastes, polymeric wastes, lignite, non-coking coals, non-caking coal fines, caking coals, degraded polymers and refuse carbonaceous materials such as tires and municipal solid waste.
63. The carbonaceous material of Claim 62 wherein said carbon-containing material has an ash content not exceeding about 40% by weight.
64. The carbonaceous material of Claim 63 wherein ash content is reduced by washing.
65. The carbonaceous material of Claim 61 wherein said carbon-containing material has an ash content not exceeding 10% by weight.
66. The carbonaceous material of Claim 65 wherein ash content is reduced by washing.
67. The carbonaceous material of Claim 61 wherein said PPC is formed by thermal conversion under thermolytic or pyrolytic environments.
68. The carbonaceous material of Claim 67 wherein thermal conversion occurs between about 250 - 800°C, at a heating rate of about 1 - 1000°C/min.

69. The carbonaceous material of Claim 61 wherein said feed modifier and said PPC are molded in different shapes.
70. The carbonaceous material of Claim 69 wherein the mold shapes have approximate dimensions like length: 1-9 inches, width: 1-9 inches and height: 0.25-6 inches.
71. The carbonaceous material of Claim 61 wherein the carbonaceous material includes 5-50% by weight of said feed modifiers.
72. The carbonaceous material of Claim 61 wherein said feed modifiers are selected from the group consisting of synthetic and natural hydrocarbons, like virgin polymers, vinyl acetates, methacrylates, ethylenes, polymeric resins, recycled automobile wastes, recycled polymeric wastes, agricultural wastes, agricultural oils and fats, molasses, biomass tar fluids and pitches, coal tar and pitches, activated carbon bases, carbon residue from industrial wastes, inorganic fractions from agricultural residues like silica from rice hulls and the like.
73. A process for production of a carbonaceous material, with a process at temperatures less than the melting point of carbon comprising: provision of a particulate carbon-containing material; production of a defined specific PPC in a thermolytic or pyrolytic environment from the carbon-containing material; mixing of a nucleating agent and the adhesion agent in the form of interactive filler with the defined PPC; forming at least one shape from the mix of PPC and feed modifier; subjecting the said shape through curing step; adhesion and nucleation of the said shape; fractionation of the feed modifier; void collapse of the said shape and return to ambient condition of the said shape.

74. The process of Claim 73 wherein the carbon-containing material is selected from the group consisting of refuse coals, coal tailings, agricultural wastes, polymeric wastes, lignite, non-coking coals, non-caking coal fines, caking coals, degraded polymers, refuse carbonaceous materials like tires, municipal solid waste.
75. The process of Claim 73 wherein the carbon-containing material has an ash content not exceeding about 40% by weight.
76. The process of Claim 73 further comprising the process for reducing ash from carbon-containing material prior to the act of producing a PPC.
77. The process of Claim 73 wherein the carbon-containing material has the reduced ash content not exceeding 10% by weight.
78. The process of Claim 73 wherein said act of producing a PPC includes thermolysis or pyrolysis of the carbon-containing material between 250 - 800°C at a heating rate of about 1 - 1000°C/min.
79. The process of Claim 73 wherein the feed modifier holds the at least one shape together in a green state.
80. The process of Claim 79 wherein the said step of curing takes place at temperatures below 300°C.
81. The process of Claim 73 wherein the at least one shape has dimensions in the range of length: 1-9 inches, width: 1-9 inches and height: 0.25-6 inches.
82. The process of Claim 73 wherein the feed modifier, acts as a nucleating agent.

83. The process of Claim 82 wherein the fractionation and separation of components from feed modifiers takes place.
84. The process of Claim 73 wherein the feed modifiers are mixed with the PPC in an amount of from 3-50% by weight.
85. The process of Claim 73 wherein the feed modifiers are selected from the group consisting of synthetic and natural hydrocarbons, like virgin polymers, vinyl acetates, methacrylates, ethylenes, polymeric resins, recycled automobile wastes, recycled polymeric wastes, agricultural wastes, agricultural oils and fats, molasses, biomass tar fluids and pitches, coal tar and pitches, activated carbon bases, carbon residue from industrial wastes, inorganic fractions from agricultural residues like silica from rice hulls and the like.
86. The process of Claim 73 wherein the feed modifiers provide a framework for maintaining nucleation and adhesion of particles of the PPC during initiation, manufacturing and completion of the process.
87. The process of step 86 takes place in the temperature range of 200 - 800°C at a rate of 1 - 200°C/min.
88. Wherein the process of step 86 takes place in a controlled atmosphere of oxygen less than 5 %, CO₂ more than 10%, water more than 10% in the bulk gas phase.
89. The process of Claim 73 wherein said act of void collapse occurs in the range of 700 - 1300°C.
90. The process of Claim 89 occurs at a rate of 0.5-60°C/min.

91. Wherein the process of step 89 takes place in a controlled atmosphere of oxygen less than 5%, CO₂ less than 10%, water less than 10% near the gas-solid interface.
92. Wherein the process of step 89 takes place in a controlled atmosphere of oxygen less than 5 %, CO₂ more than 10%, water more than 100% in the bulk gas phase.
93. Wherein the process of step 89 has the temperature gradient of 200 - 400°C.
94. Wherein the process of step 89 has the evolved gases subjected to *in situ* oxidation or drafted to controlled oxidation chamber.
95. Wherein the gases from the process of step 94 are utilized for gas clean up train for co-generation.
96. The process of Claim 73 wherein said act of void collapse is carried out under natural or forced convection mode.
97. The process of Claim 73 wherein the said act of controlled cooling of molds is carried out by convective process.
98. A process for the production of carbon alloys at process temperature below the melting point of carbon, comprising: providing a refuse or virgin carbonaceous material; reducing the quantity of inorganic materials from the carbonaceous material at a temperature below the melting point of carbon; thermolysis or pyrolysis of the refuse or virgin carbonaceous material to form specialty PPC at a temperature below the melting point of carbon; mixing adhesion and nucleating

agent, in the form of feed modifiers, with the PPC to provide a framework for maintaining adhesion and nucleation of PPC particles during and completion of the process at a temperature below the melting point of carbon; molding the PPC and feed modifier mix in a plurality of molds to form a plurality of shaped material; curing the shaped material in a convective process; fractionation of feed modifiers during thermolysis or pyrolysis; pyrolysis of PPC in the molded shaped material at a temperature below the melting point of carbon; collapsing voids in the plurality of shaped material using a forced or natural convective process at a temperature below the melting point of carbon; controlled cool down of the plurality of shaped material to produce the carbon alloys.

99. The process of Claim 98 wherein the refuse or virgin carbonaceous material is selected from the group consisting of refuse coals, coal tailings, agricultural wastes, polymeric wastes, lignite, non-coking coals, non-caking coal lines, caking coals, degraded polymers, refuse carbonaceous tires and municipal solid waste.
100. The process of Claim 98 wherein the carbonaceous material has an ash content not exceeding 40% by weight.
101. The process of Claim 100 further comprising reduction of inorganics from the carbonaceous material prior to said thermolysis or pyrolysis.
101. The process of Claim 100 further comprising lowering the concentration of inorganics from the carbonaceous material prior to said thermolysis or pyrolysis.
102. The process of Claim 101 wherein the carbonaceous material has an ash content not exceeding 10% by weight.

103. The process of Claim 98 wherein said fractionation of feed modifiers occurs between 200 - 800°C at a heating rate of 1 - 200°C/min.
104. The process of Claim 98 wherein said adhesion and nucleation of PPC occurs between 200 - 800°C at a heating rate of 1 - 200°C/min.
105. The process of Claim 98 wherein the feed modifiers are selected from the group consisting of synthetic and natural hydrocarbons including virgin polymers, vinyl acetates, methacrylates, ethylenes, polymeric resins, recycled automobile wastes, recycled polymeric wastes, agricultural wastes, agricultural oils, agricultural fats, molasses, biomass tar fluids, biomass tar pitches, coal tar coal pitches, activated carbon, carbon residue from industrial wastes, and inorganic fractions from agricultural residues.
106. The process of Claim 98 wherein the feed modifiers provide framework for maintaining adhesion and nucleation of particles of the PPC during and on the completion of said act of void collapse.
107. The process of Claim 98 wherein said act of void collapse occurs in the range of 700° - 1300°C.
108. The process of Claim 107 wherein said act of void collapse occurs at heating rate of 1 - 200°C/min.
109. The process of Claim 98 wherein said act of void collapse takes place in convective process.

110. A method of making a carbon alloy at a temperature below the melting point of carbon, comprising:

- a) selecting a carbon based feed material;
- b) heating said carbon based feed material in a temperature range to devolatilize constituents and to form active nucleation sites for carbon;
- c) controlling the rate of heating to adjust reactivity of said active nucleation sites;
- d) adding a feed modifier to said devolatilized carbon base material to produce a modified mixture of devolatilized carbon material;
- e) placing said mixture of modified devolatilized carbon material into a compaction mold;
- f) curing the mixture modified devolatilized carbon material with pressure and heat in said compaction mold to produce a molded shape carbon alloy;
- g) collapsing voids in said molded shape carbon alloy by additional heating ; and
- h) cooling said molded and void collapsed carbon alloy so that the maximum difference of temperature within said molded shape carbon alloy is less than 500°C.

111. A method of making a carbon alloy at a temperature below the melting point of carbon comprising:

- a) selecting a carbon based feed material and feed enhancers for enhancing nucleation having a combined fixed carbon content greater than 25 wt%;
- b) controlling ash content of the base feed material by measurement and adjustment to a desired ash content;
- c) heating said carbon based feed material at a temperature in a range of 250 °C to 800°C to devolatilize constituents and to form active nucleation sites for

carbon;

d) controlling the rate of heating in a range of 1°C/min to 1000°C/min to adjust reactivity of said active nucleation sites;

e) adding a fluidity enhancer selected from the group comprising polymers, tar, pitch and molasses ~~carbon base material~~ to produce a mixture of fluidity ~~[and strength]~~ enhanced devolatilized carbon material;

f) adding a strength enhancer selected from the group comprising silica and coke breeze to produce a mixture of strength enhanced devolatilized carbon material;

g) blending said fluidity enhanced devolatilized carbon and said strength enhanced devolatilized carbon into a blended mixture of carbon material;

h) placing said blended mixture of fluidity enhanced and strength enhanced devolatilized carbon material into a compaction mold and compacting at a temperature up to 300°C and a pressure range of 4000psi to 20,000psi;

i) curing the blended mixture of enhanced devolatilized carbon material at a temperature less than 300°C to produce a ~~[molded shape carbon]~~ carbonaceous material mixture having a molded shape ;

j) nucleating and adhering the carbon in the carbonaceous material mixture having the molded shape, by heating at a rate in the range of 1°C/min to 100°C/min up to a temperature in the range of 300°C to 700°C ;

k) collapsing voids in said carbonaceous material mixture having the molded shape by heating at a rate of about 5 °C /min to 200°C/ min to a temperature in the range of about 700°C to a temperature below the melting point of carbon; and

l) cooling said molded and void collapsed carbonaceous material mixture in flue gases so that the maximum difference of temperature between any two locations within said molded shape of said carbonaceous material mixture is less than 500°C.